The area of contamination requiring soil cleanup is shown on Figure 12, and extends from the Property onto three neighboring properties: Captain's Landing, the Twin Spits Rd right-of-way, and the church property.

The cleanup area covers part of the 1994 excavation, which contains backfill not needing cleanup. The area also extends some unknown distance beneath the general store building as shown by the queries on Figure 12. In most of the soil cleanup area, the zone of contamination is likely to be at and near the water table from 4 to 7 feet below ground surface. Soils above this depth likely do not contain hydrocarbons at concentrations exceeding cleanup levels.

The approximate volume of soil requiring excavation is 2100 cubic yards (including the former excavation backfill), as measured over an area of 180 ft by 45 feet in plan dimension, and extending to a depth of 7 feet. Of this quantity, about 50% should not be contaminated at concentrations above cleanup levels. The total volume requiring treatment or disposal is therefore an estimated 1050 cubic yards, which would expand to about 1400 cubic yards, assuming a 30% "fluff factor". The total weight of this volume is estimated to be 1550 tons, assuming an in-place density of 110 lbs/cu ft.

2.8.4 AREAS OF GROUND WATER REQURING CLEANUP

The estimated area of ground water contamination requiring cleanup is also shown on Figure 12. Because the boundaries of this area were determined largely on the basis of ground water grab sample data, the actual area requiring cleanup is likely to be less.

2.9 DATA GAPS

No data gaps were identified for this Site that would prevent the selection of a cleanup action.

3.0 FEASIBILITY STUDY

3.1 CLEANUP OBJECTIVES

MTCA outlines the following minimum cleanup objectives:

- Protect human health and the environment
- Comply with cleanup standards
- Comply with applicable laws
- Provide for compliance monitoring
- Provide a reasonable restoration time-frame
- Use permanent solutions to the maximum extent practicable
- Consider public concerns
- Achieve source control

Additional specific objectives for remedial action at this Site include the following:

- Provide for the continued operation of the general store as a community amenity
- Allow continued use of Twin Spits Rd for local traffic during the cleanup action
- Protect the quality of water in the Kitsap PUD main that passes through the Site
- Achieve a complete cleanup of the Site within a short time period as a means of completing and satisfying the work outlined in the Consent Decree

3.2 APPLICABLE RELEVANT AND APPROPRIATE REQUIREMENTS

MTCA requires that cleanup actions comply with applicable state and federal laws [WAC 173-340-360(2)]. MTCA defines applicable state and federal laws to include "legally applicable requirements" and "relevant and appropriate requirements" (ARARS). ARARS for the implementation of the cleanup action at this site follow.

Federal Requirements

- Clean Water Act
- Clean Air Act
- Resource Conservation and Recovery Act (RCRA)
- Occupational Safety and Health Act (29 CFR 1910)
- Safe Drinking Water Act
- Rules for Transport of Hazardous Waste (49 CFR 107, 49 CFR 171)

State Requirements

- Model Toxics Control Act Regulations (WAC 173-340)
- Dangerous Waste Regulations (WAC 173-303)
- Minimum Standards for Construction and Maintenance of Wells (WAC 173-160) Regulation and Licensing of Well Contractors and Operators (WAC 173-162)
- State Clean Air Act, Chapter 70.94 RCW
- Washington Industrial Safety and Health Act Regulations (WAC 296-62)
- Water Pollution Control Act, Chapter 90.48 RCW
- Water Quality Standards for Surface Waters of the State of Washington (WAC173-201A)
- Water Quality Standards for Groundwater of the State of Washington (WAC 173-200)
- Underground Injection Control (WAC 173-218)
- Maximum Environmental Noise Levels (WAC 173-60)

Local Requirements

- Kitsap County Grading Permit
- Puget Sound Clean Air Agency Regulations

All actions carried out by Ecology or Ecology's contractor under the Consent Decree must be done in accordance with all applicable federal, state, and local requirements, including requirements to obtain necessary permits, except as provided in RCW 70.105D.090. The permits or other federal, state or local requirements that the agency has determined are applicable and that are known at this time are listed above. Under RCW 70.105D.090(1), Ecology and its consultants are exempt from the procedural requirements of Chapters 70.94, 70.95, 70.105, 77.55, 90.48, and 90.58 RCW and of any laws requiring or authorizing local government permits or approvals. However, Ecology and its consultants shall comply with the substantive requirements of such permits or approvals. During remedial action, Ecology and its consultants must continue to determine whether additional permits or approvals addressed in RCW 70.105D.090 (1) would otherwise be required for the remedial action under the Consent Decree. Ecology will be responsible for contacting the appropriate state and/or local agencies and working with those agencies to determine the substantive requirements those agencies believe are applicable to the remedial action. Pursuant to RCW 70.105D.090(2), in the event Ecology determines that the exemption from complying with procedural requirements of the laws referenced in RCW 70.105D.090(1) would result in the loss of approval from a federal agency that is necessary for the State to administer any federal law, the exemption will not apply and Ecology and its consultants will comply with both the procedural and substantive requirements of the laws referenced in RCW 70.105D.090(1) including any requirements to obtain permits.

3.3 INITIAL SCREENING OF CLEANUP COMPONENTS

The following technologies have been used to remediate petroleum contamination:

- Excavation and off-site Disposal
- Excavation and off-site Solid Phase Treatment

- Ex-situ Thermal Desorption
- In-situ Thermal Treatment
- Dual-Phase Extraction
- Air Sparging and Soil Vapor Extraction
- Chemical Oxidation
- Natural Attenuation
- Enhanced Bioremediation
- Containment
- Permeable Reactive Barriers

3.3.1 EXCAVATION AND OFF-SITE DISPOSAL

This technique has seen widespread use and is particularly effective with shallow soil contamination. It consists of excavating the contaminated soil and trucking it offsite for disposal. This process also serves to remove the source of ground water and soil vapor contamination.

For the Hansville Site, the depth of soil excavation would be quite shallow and easily accomplished. Furthermore, there are two fairly close soil disposal facilities – Olympic View Transfer Station located south of Bremerton, and the Rinker pit in Snohomish County. There are also manufacturing facilities that will accept contaminated soil as feedstock. One such company in Seattle, La Farge, is a cement manufacturer.

This method will therefore be retained for further evaluation.

3.3.2 EXCAVATION WITH NEARBY SOLID PHASE TREATMENT

This technique involves excavating soil and then placing it in a controlled location for enhanced biological, chemical, or physical treatment. Typically the contaminated soil is placed on a bermed liner and, depending on the season, covered with a material that sheds rainfall (i.e. visqueen sheeting). Nutrients or chemicals are then added to the soil and it is periodically worked via a tilling process. The tilling increases oxidation and enhances biological degradation processes. Periodic sampling is conducted to document the rate of degradation and to establish when cleanup levels have been achieved. The soil can then be reused at the Site or at other locations, depending on the concentrations remaining in soil. This method works best during the summer months when temperatures are warm and there is little rain. It also works well with GRO-contaminated soils, and less well with DRO contamination.

This method can be highly advantageous where the contaminated site is a long distance from any disposal sources, and there is a sufficiently large area available on a property for the tilling operation. The method also tends to be less costly than other methods. One disadvantage is the potential for excessive hydrocarbon fumes if the soil is highly contaminated. A more significant disadvantage is that the excavation must remain open until the contaminated soil has been cleaned up, unless new backfill is brought in. If new fill is brought in, the cleaned-up soil will need to be disposed of at some other location.

For the Hansville Site, the remedial excavation would extend into the road and would thus need to be backfilled as soon as possible for traffic safety. Further, the Hansville General Store property is not large enough for a treatment site, and there may be difficulties locating a new location for the cleaned-up soil.

Despite these drawbacks, this option will be retained for further evaluation because of the potential cost savings involved.

3.3.3 EX-SITU THERMAL DESORPTION

Low-temperature thermal desorption, (also known as low-temperature thermal volatilization, thermal stripping, and soil roasting) uses heat to physically separate petroleum hydrocarbons from excavated soils. Thermal desorbers heat soils to temperatures sufficient to volatilize and desorb (physically separate) petroleum hydrocarbons from the soil. The vaporized hydrocarbons are generally treated in a secondary treatment unit (an afterburner, for example) prior to discharge to the atmosphere.

Thermal desorption systems fall into two general classes – stationary facilities and mobile units. Contaminated soils are excavated and transported to stationary facilities; mobile units can be operated directly onsite to process the excavated soils. Desorption units are available in a variety of process configurations including rotary desorbers, asphalt plant aggregate dryers, thermal screws, and conveyor furnaces. (EPA 2004.) Only mobile units are considered here because off-site transport is one of the options open under 3.3.1.

In general the advantages of this technique are rapid treatment time, consistent ability to reduce TPH to below 10 ppm, ability to handle very high concentrations of petroleum hydrocarbons, reduction of costs for fill if treated soil is permitted to be redeposited onsite, and competitive cost for large volumes. Disadvantages include space requirements for the unit and soil storage, high costs for small volumes of soil, and the requirement to dewater soils because high moisture content requires high energy input to heat.

For the Hansville site, the need for up to ½ acre of space just for the unit for the unit and soil processing stockpiles, and the high cost of mobilization, makes this an unfeasible option.

This component will therefore not be carried forward in the analysis.

3.3.4 IN-SITU THERMAL TREATMENT MEASURES

In situ thermal treatment methods mobilize harmful chemicals by heating them. The heated chemicals move through the soil and groundwater toward underground wells, where they are collected and piped to the ground surface for treatment.

The methods of providing the heat are numerous, including steam injection, hot air injection, hot water injection, electrical resistance heating, radio frequency heating, and thermal conduction. The strength of these methods is removing non-aqueous phase liquids, often from relatively deep zones and sometimes from clay, without moving large amounts of soil.

Because the Hansville property has relatively shallow contamination beneath a busy road and a well used community general store, it would present challenges in providing for the capture of mobilized chemicals at the surface. The various heating methods also utilize large specialized equipment, which would have a difficult time operating on this small of a Site.

This option will not be considered further for the Hansville Site.

3.3.5 DUAL-PHASE EXTRACTION

Dual-phase extraction (also known as multi-phase extraction, vacuum enhanced extraction, or bioslurping) is an in-situ technology that uses pumps to remove various combinations of contaminated groundwater, free product and hydrocarbon vapor from the subsurface. (EPA 2004)

This technique is at its best in removing free product and gasoline contamination, but has a long time-frame for achieving final ground water and soil cleanup, and does not work well with diesel contamination.

For these reasons, this technique will not be considered further for the Hansville site.

3.3.6 AIR SPARGING AND SOIL VAPOR EXTRACTION

Air sparging (also known as "in-situ air stripping" and "in-situ volatilization") is a remedial technology that reduces concentrations of volatile constituents in petroleum products that are adsorbed to soils and dissolved in groundwater by the injection of air into the saturated zone, enabling a phase transfer of hydrocarbons from a dissolved state to a vapor phase. The air then escapes through the unsaturated zone.

Air sparging (AS) is often used together with soil vapor extraction (SVE). The SVE system creates a negative pressure in the unsaturated zone through a series of extraction wells to capture and control the vapor plume (EPA 2004).

As with any in-situ technology, AS/SVE often takes a long time before soil and ground water reach cleanup levels. Moreover the efficacy of this method is highly dependent on a uniform delivery of the injected air into contaminated areas, a process which is often difficult to achieve even with a large number of injection points. Sparging also only works well with gasoline-range contaminants. The main objection, however, is that the system tends to pull in water and to cease operating when ground water is shallow, like it is at the Hansville Site.

This option will therefore not be considered further.

3.3.7 CHEMICAL OXIDATION

Chemical oxidation seeks in-situ destruction of petroleum contaminants by injecting one of a variety of oxidants (e.g. hydrogen peroxide, Fenton's Reagent, permanganate, ozone, RegenOx^{TM}) into the subsurface. In some cases the chemical oxidation produces a strong exothermic reaction, potentially posing a threat to buried utilities or a safety issue for surface activities.

This method works best where a Site is fairly remote, or where the contamination is deep and not easily reached. Its' primary advantage is the rapidity of hydrocarbon breakdown and site cleanup. Its' primary disadvantages are safety and the need for multiple injection points to achieve contact between the contaminant and oxidant.

For the Hansville site, use of a strong oxidant could be unsafe for the existing businesses and would require multiple injections within the road right-of-way and near the store. It also would need to be injected in the area of the Kitsap PUD water main, which could damage the main.

3.3.8 NATURAL ATTENUATION

Natural Attenuation refers to physical, chemical or biological processes that act without human intervention to clean up hazardous substances in the environment. These processes include natural biodegradation; dispersion; dilution by recharge; sorption; volatilization; and chemical or biological stabilization, transformation, or destruction of hazardous substances.

Natural attenuation will not provide for a reasonable restoration time frame at the Site. Contamination was discovered 19 years ago, and sampling conducted as recently as 4 years ago showed contaminant levels at more than 100 times Method A cleanup standards. This indicates that human intervention will be required to achieve cleanup in a reasonable timeframe at this property.

This option will therefore not be considered further.

3.3.9 ENHANCED BIOREMEDIATION

Enhanced bioremediation involves introducing solutions containing oxygen, nutrients, and/or microbes into the saturated soil that will accelerate the natural processes described above under natural attenuation.

This technology is primarily useful for remediation of ground water and soil below the water table, since bioremediation solutions tend to pass downward through the unsaturated zone with little contact between solution and soils. Enhanced bioremediation has the advantages of being relatively inexpensive and easy to implement, and creates little disruption to existing site conditions. It is also a good choice where contamination can not be physically removed. The primary disadvantages are a lengthy cleanup period and difficulty in establishing a uniform distribution of bioremediation solution within the contaminated area. This is particularly true for heterogeneous geologic conditions and subsurface soils that contain significant silts or clays.

For the Hansville site, it is likely a remediation approach with just enhanced bioremediation would take too long to complete, and would not, in any case, address contaminated soils above the water table. Injecting solution into the portion of the Site below the road could also be disruptive to road use and safety, given the spacing density that would be needed to assure solution delivery to the entire contaminant plume. However, geologic conditions at the Site are relatively homogeneous and conducive to good contact between solution and soil/water.

Enhanced bioremediation itself, will therefore not be retained as a stand-alone option, but will be retained for possible use in conjunction with other alternatives.

3.3.10 CONTAINMENT

According to MTCA, "Containment means a container, vessel, barrier, or structure, whether natural or constructed, that confines a hazardous substance within a defined boundary and prevents or minimizes its release into the environment." (WAC 173-340-200). When employed as the primary component of a remedial action, containment is used to leave a hazardous substance in place, and isolate it from the environment. Some types of containment are engineered caps, slurry walls, and sheet piles. Containment systems often include ground water extraction from within the contained area to maintain hydraulic control, and a treatment system for the extracted ground water.

Containment is most advisable when cleanup of a Site is impractical or impossible, but contamination needs to be controlled to prevent current or future environmental damage. The principal advantage of containment is that it does provide for control/elimination of environmental risk. The principal disadvantages are contamination remaining as a legacy for future owners, high front-end costs, indeterminate long-term O&M costs, and uncertainty about long-term ownership and maintenance of the containment system.

For the Hansville site, a containment system would require a subsurface wall encircling the contaminated area, along with an "impermeable" cap. The wall and cap would prevent water and contaminant movement in and out. A ground water extraction and treatment system would be required to maintain an inward hydraulic gradient. This kind of remediation would not provide for a reasonable restoration time frame, and might present an ongoing maintenance liability to Ecology under terms of the Consent Decree. There would also be technical difficulties dealing with the tidal influence on ground water.

This option is therefore not considered further.

3.3.11 PERMEABLE REACTIVE BARRIERS

Permeable reactive barriers (PRBs) are a variant on containment systems. Instead of containing ground water and soil, however, PRBs include a combination of low permeability and high permeability subsurface walls or trenches which direct and treat ground water as it moves through the Site. The low-permeability walls are made out of materials such as steel sheet piling or cement-bentonite slurry, and serve to funnel or direct ground water movement. The permeable walls contain a variety of reactive materials, such as zero-valent iron, chemical oxidizers, or Fenton's Reagent, which adsorb or break down contaminants as ground water passes through the wall.

The primary advantage of this technology is to have a relatively low cost, passive system that will work to clean up ground water over a long period of time. It is most useful when a shorter restoration time frame is not feasible or possible, and in situations where the greatest environment risk is associated with the off-property discharge of contaminated ground water, such as into a stream or lake. The primary disadvantages of this technology are the need for long-term monitoring and the great length of time required for complete cleanup. There can also be technical challenges in determining the precise type of treatment media required, and the system layout needed to achieve plume control.

For the Hansville site, a treatment wall system would be difficult to design given the dynamic changes in ground water flow directions that occur as a result of tidal fluctuations. It would also not reduce any of the soil vapor intrusion risks in the central portion of the Site, and might present an ongoing maintenance liability to Ecology under terms of the Consent Decree. Finally, the cleanup would take a long time to complete, because it is essentially a passive flow-through system combining natural attention with perimeter treatment.

This option is therefore not considered further.

3.4 NON-REMEDIATION COMPONENTS

3.4.1 WATER LINE REPLACEMENT

An 8-inch diameter asbestos-concrete water supply pipeline passes directly through the Site as described previously in Section 2.3.4, and shown on Figure 12. The pipe is close to the water table and may be in direct contact with contaminated soils and/or ground water. The line is at risk on two fronts: (1) Contaminants present at the Site may have permeated the pipe and be leaching into the water supply, and (2) Construction activities associated with Site remediation could damage the pipe. Replacement of this pipe is therefore considered a necessary part of the Site cleanup. Design and construction of the replacement pipe will need to be completed in coordination with Kitsap PUD.

3.4.2 ROAD RECONSTRUCTION

Twin Spits Rd passes directly through the middle of the Site, as described previously, and as shown on Figure 12. This road is a main arterial for areas west of Hansville. Although there is an alternative route into these areas, Twin Spits Rd is the quickest and most direct. As such, planning for the cleanup action must maintain road usability at all times for both residential and emergency response use.

3.4.3 HANSVILLE GENERAL STORE BUILDING RELOCATION

Remedial alternatives involving soil excavation might include moving the store building temporarily. The store is an important amenity to the local community both as a source of supplies and as a gathering place. It has apparently served these purposes since the early 1900s.

Any remedial action will need to allow continued operation of the store during construction to the degree possible, and to provide for full store functionality following construction.

3.5 SELECTION AND DESCRIPTION OF ALTERNATIVES

MTCA requires alternatives be selected for evaluation that include the following:

- A reasonable number and type of alternatives
- Alternatives that protect human health and the environment by eliminating, reducing, or otherwise controlling risks
- Alternatives that have the standard point of compliance for all affected media, unless they are not technically possible or are disproportionately costly for the benefit obtained
- At least one permanent cleanup action alternative, unless they are not technically possible or are disproportionately costly for the benefit obtained

MTCA also establishes expectations for cleanup under WAC 173-340-370 that should be considered in formulating the alternatives, even though these expectations are not explicit evaluation criteria. Expectations potentially applicable to this Site include:

- Cleanups should minimize long-term management, through destruction or removal of hazardous substances
- Cleanups near surface water bodies should actively prevent or minimize releases to surface water via runoff or ground water discharge

Ecology has also established the following criterion for this specific Site:

- The cleanup must be permanent if at all possible, so that the Consent Decree can be closed out in an expeditious manner.

Four alternatives that meet these criteria have been developed for detailed evaluation. They are:

- Alternative 1: Complete soil excavation with offsite disposal and ground water treatment
- Alternative 2: Complete excavation with nearby solid phase treatment and ground water treatment
- Alternative 3: Partial excavation with ground water treatment
- Alternative 4: Partial excavation with ground water treatment and soil vapor venting

3.5.1 ALTERNATIVE NO. 1: COMPLETE SOIL EXCAVATION WITH OFFSITE DISPOSAL AND GROUND WATER TREATMENT

This alternative consists of the following:

- The general store building is temporarily moved.
- Utilities that pass through the Site are temporarily re-routed.

- Pavement and other surface features in the area of soil contamination are removed.
- "Clean" soil placed as backfill during the 1994 interim action is excavated and stockpiled for later reuse. Other clean soils present at shallow depth are also excavated and stockpiled for later reuse.
- The edges of the excavation are shored or otherwise stabilized to allow soil removal below the water table.
- Contaminated soil is excavated to a depth of 7 feet (about 2 or 3 feet below the water table).
- Compliance samples are obtained from the base and sides of the excavation to confirm that remaining soils meet cleanup levels.
- Contaminated soil is transported to a permitted disposal facility.
- The excavation is backfilled as soon as practicable.
- Provisions are made to allow at least one lane of traffic to be open at all times during the excavation work.
- A new domestic water line is installed through the Site.
- Twin Spits Rd. is repaved.
- The general store is moved back, utilities are reconnected, and any necessary repairs to the store are completed.
- Contaminated ground water outside the area of soil contamination is treated with solutions that enhance bioremediation. The specific number, location, and scheduling of injection points will be established in the engineering plans and specifications.
- Post-construction ground water monitoring is implemented to track contaminant reduction in the plume. Ground water is expected to meet cleanup standards within two years.

3.5.2 ALTERNATIVE NO. 2: COMPLETE SOIL EXCAVATION WITH NEARBY SOLID PHASE TREATMENT AND GROUND WATER TREATMENT

This alternative is the same as No. 1, except for the following:

- Excavated soils are placed in a bermed treatment area on the adjoining property(s).
- Nutrients are added to the soil and it is tilled on a scheduled basis to enhance biodegradation.
- A temporary cover is provided for the bermed area to prevent storm water runoff from being contaminated.
- Soil samples are obtained for chemical analysis on a periodic basis from the soils being treated to document contaminant reduction with time and that cleanup levels have been met.
- Soil that meets cleanup levels is transported to a separate property in the local area to be used as fill.
- The treatment area is restored to its original condition.

3.5.3 ALTERNATIVE NO. 3: PARTIAL SOIL EXCAVATION WITH OFF-SITE DISPOSAL, AND GROUND WATER TREATMENT

The primary difference between this alternative and the previous alternatives is that the store would not be moved, and contaminated soil and ground water beneath the store would be cleaned up through enhanced bioremediation. This method should work because the contamination beneath the store should primarily be at and below the water table. The following specifics would apply to this alternative:

- Southern edge of store foundation is shored to allow soil excavation
- Contaminated soil is excavated up to edge of building
- The enhanced bioremediation system is expanded to include fluid injection beneath the store building via horizontal or inclined wells
- Nearly continual access is provided to the general store during construction

3.5.3 ALTERNATIVE NO. 4: PARTIAL SOIL EXCAVATION WITH OFF-SITE DISPOSAL, GROUND WATER TREATMENT, AND SOIL VAPOR VENTING

This alternative is the same as No. 3 except that passive vent pipes are installed beneath the general store to prevent soil vapor buildup and to enhance contaminant degradation in the unsaturated zone.

3.5 EVALUATION OF ALTERNATIVES

A cleanup action must meet certain minimum or threshold requirements under MTCA (WAC 173-340-36-(2)(a)) as follows:

- Protect human health and the environment
- Comply with cleanup standards
- Comply with applicable state and federal laws
- Provide for compliance monitoring

MTCA also requires that cleanup actions:

- Use permanent solutions to the maximum extent practicable
- Provide for a reasonable restoration time frame
- Consider public concerns

For comparison between alternatives, MTCA provides the following evaluation criteria:

- Protectiveness
- Permanence
- Long-term effectiveness
- Short-term risk management